Claims

1. A method of labeling digital image data associated with a compound document in a single pass, comprising:

receiving image data;

distributing the image data to multiple branches, wherein at least two of the multiple branches include filters configured to blur the image data at different resolutions;

detecting edges of the blurred image data at the different resolutions;

detecting edges of unfiltered image data;

combining data output from the at least two of the multiple branches; and

determining whether the combined data is to be labeled as a low resolution halftone.

2. The method of claim 1, wherein the method operation of detecting edges of the blurred image data at the different resolutions includes,

suppressing halftones associated with the image data at a first suppression level in a first branch of the at least two of the multiple branches; and

suppressing the halftones at a second suppression level in a second branch of the at least two of the multiple branches.

3. The method of claim 1, wherein the method operation of combining data output from the at least two of the multiple branches includes,

performing a logical AND operation with output from the at least two of the multiple branches to identify an edge.

4. The method of claim 1, wherein a number of the multiple branches is equal to three.

5. The method of claim 1, wherein the method operation of determining whether the combined data is to be labeled as low resolution halftone data includes,

counting a number of logical values associated with real edges;

comparing the number with a threshold value;

if the number is greater than or equal to the threshold value, then the method includes,

labeling a region associated with the combined data as a low resolution halftone region.

6. A method of segmenting a compound document for enhancement during replication of the compound document, comprising:

filtering data representing a portion of the compound document through a filter associated with a first resolution;

filtering the data representing the portion of the compound document through a filter associated with a second resolution;

detecting edges on both, an output of the filter associated with the first resolution and an output of the filter associated with the second resolution;

combining data representing detected edges from both outputs; and

determining whether a pixel corresponding to the data representing the detected edges is over a halftone region.

7. The method of claim 6, wherein the method operation of determining whether pixels corresponding to the data representing the detected edges are over a halftone region includes,

subtracting the combined data from the output of the filter associated with the second resolution;

counting a neighborhood of pixel values around the pixel; and

thresholding a result of the counting.

8. The method of claim 7, wherein the method operation of counting a neighborhood of pixel values around the pixel includes,

defining two subsets of the neighborhood; and

separately counting pixel values associated with each of the two subsets.

9. The method of claim 8, further comprising:

scaling down a main threshold proportionately to an area of a corresponding subset of the neighborhood; and

comparing results of the separate counting to corresponding scaled thresholds.

10. The method claim 6, further comprising:

detecting edges on unfiltered data;

combining data representing edges from the unfiltered data and the output of the filter associated with the second resolution; and

identifying halftone regions from the combination of the data representing edges from the unfiltered data and the output of the filter associated with the second resolution.

11. The method of claim 6, wherein the first resolution causes a more pronounced blurring effect relative to the second resolution.

12. A computer readable medium having program instructions for segmenting a compound document for enhancement during replication of the compound document, comprising:

program instructions for filtering data representing a portion of the compound document through a filter associated with a first resolution;

program instructions for filtering the data representing the portion of the compound document through a filter associated with a second resolution;

program instructions for detecting edges on both, an output of the filter associated with the first resolution and an output of the filter associated with the second resolution;

program instructions for combining data representing detected edges from both outputs; and

program instructions for determining whether a pixel corresponding to the data representing the detected edges is over a halftone region.

13. The computer readable medium of claim 12, wherein the program instructions for determining whether pixels corresponding to the data representing the detected edges are over a halftone region includes,

program instructions for subtracting the combined data from the output of the filter associated with the second resolution;

program instructions for counting a neighborhood of pixel values around the pixel; and

program instructions for thresholding a result of the counting.

14. The computer readable medium of claim 13, wherein the program instructions for counting a neighborhood of pixel values around the pixel includes,

program instructions for defining two subsets of the neighborhood; and

program instructions for separately counting pixel values associated with each of the two subsets.

15. The computer readable medium of claim 12, further comprising:

program instructions for detecting edges on unfiltered data;

program instructions for combining data representing edges from the unfiltered data and the output of the filter associated with the second resolution; and

program instructions for identifying halftone regions from the combination of the data representing edges from the unfiltered data and the output of the filter associated with the second resolution.

16. The computer readable medium of claim 12, wherein the first resolution is configured to cause greater blurring of unfiltered data relative to the second resolution.

17. An image replication system, comprising:

a labeling module configured to segment image data corresponding to a compound document, the labeling module including,

multiple branches including edge detection modules for detecting edges of the compound document, a plurality of the multiple branches capable of filtering the image data at different resolutions;

logic for combining output of at least two of the multiple branches in order to initially identify a portion of the compound document as a halftone portion; and

a counting module configured to count pixel values within a neighborhood to determine whether the initially identified halftone portion is finally labeled as a halftone region.

18. The image replication system of claim 17, wherein the counting module includes,

a threshold module configured to compare a pixel counting result to a threshold value, wherein if the threshold value is less than or equal to the pixel counting result, then the initially identified halftone portion is finally labeled as the halftone region.

19. The image replication system of claim 17, wherein the multiple branches include a single branch capable of performing edge detection on unfiltered data.

20. The image replication system of claim 17, wherein the labeling module further includes:

a labeling module configured to further label the halftone region as one of a text on halftone region and a no-text on halftone region.

21. The image replication system of claim 17, further comprising:

a descreening module configured to descreen data associated with the halftone region that is received from the labeling module, the descreening module further configured to output the filtered image data corresponding to one of the different resolutions.

22. The image replication system of claim 21, further comprising:

an enhancement module configured to enhance edges through an unsharp masking scheme.

23. The image replication system of claim 22, wherein the halftone portion is a low resolution halftone portion, the low resolution halftone portion being defined as a halftone region without edges when processed through a branch without filtering capability and a halftone region having edges when processed through one of the plurality of the multiple branches capable of filtering.

24. The image replication device of claim 17, wherein the image replication device is a device selected from the group consisting of a copier, a printer, a scanner, and a facsimile.

25. An integrated circuit capable of segmenting image data corresponding to a compound document, comprising:

labeling circuitry configured to identify an image data region type, the labeling circuitry having multiple branches, each of the multiple branches including,

filter circuitry capable of filtering the image data, each of the multiple branches associated with a different filter resolution; and

edge detection circuitry configured to detect edges of the filtered image data;

the labeling circuitry further including, circuitry for combining at least two outputs of the multiple branches; and

circuitry for identifying the image data region type based upon a value defined through the circuitry for combining the at least two outputs of the multiple branches.

26. The integrated circuit of claim 25, wherein the filter circuitry is configured to low pass filter the image data in order to blur halftones prior to edge detection.

27. The integrated circuit of claim 25, wherein the circuitry for combining at least two outputs of the multiple branches includes,

circuitry for adding the at least two outputs; and

circuitry for subtracting a result of the circuitry for adding from one of the at least two outputs.

28. The integrated circuit of claim 25, wherein the circuitry for identifying the image data region type includes,

counting circuitry configured to compute a pixel value count within a neighborhood defined around a pixel of the image data; and

comparison circuitry configured to compare the pixel value count with a threshold value to determine a label associated with the image data region type.

29. The integrated circuit of claim 25, further comprising:

descreening circuitry configured to blur halftone regions; and

enhancement circuitry configured to define edges over the blurred halftone regions.